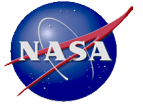


National Aeronautics and Space Administration



ICNS 2017

Airport Information Sharing Concept Architecture

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Outline

- 1. Introduction**
- 2. Project Description**
- 3. Airport Architecture Concept**
- 4. Requirements Development**
- 5. Use Cases and Information Flows**
- 6. Future Work and Conclusion**



Introduction

- Statistics collected by US DOT (2016):
 - 23,911 commercial flights daily
 - 2,246,004 passengers fly every day
 - 8,727,691 commercial flights in 2015
 - 2.1% annual growth over next 20 yrs. (FAA)
- Today's airports are complex operations that depend on the efficient and timely execution of many different functions by stakeholders.
- There is an increasing need for timely exchange of information among all service providers to enable higher efficiency, safety and economic gains.



2. Project Description



Airport Information Sharing Architecture

Develop an airport information sharing architecture that enables seamless exchange of timely information among stakeholders for the improvement of NAS operations

Challenge: Increase airport real time information exchange among stakeholders

Objectives

- Increase airport capacity
- Improve gate turnaround time
- Improve on-time departures
- Improve NAS efficiency, capacity and safety of operations
- Optimize Airline, ANSP, Airport operations.
- Efficient management during off-nominal operations e.g. weather
- Advance Airport Collaborative Decision Making

Benefits

- ATM optimization based on full view, real time airport information and increased system predictability
- Operational improvements by implementing advances in networking, communications and information management
- Context Awareness – Total view of airport status (facilities/assets, operations, users)
- Improve airport tenant decision making capabilities.

Goal: Enable Seamless Information Exchange and activate new NAS Capabilities



Project Plan

Needs Analysis

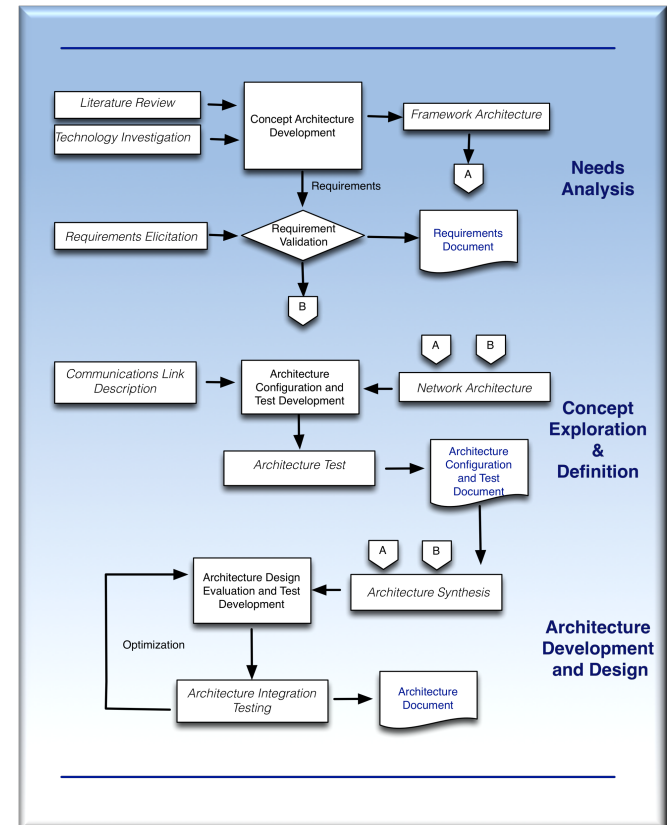
- Requirements Development and Analysis
- Concept Architecture Development

Concept Exploration and Definition

- Communications Link Description/Selection
- Network Architecture
- Architecture Configuration and Test Development
- Architecture Test

Architecture Development and Design

- Architecture Synthesis
- Architecture Test Development
- Architecture Integration testing

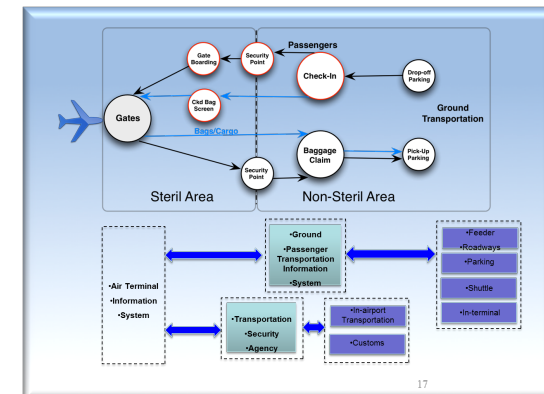
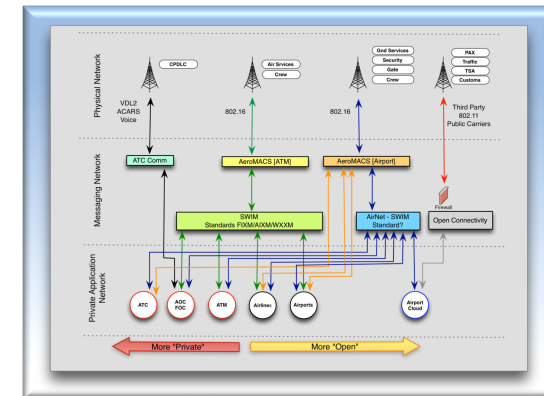


FY-2016 Accomplishments

Concept Architecture Framework

- **Literature Review**
 - NextGen Architecture Configuration (Today – 2025)
 - Beyond NextGen Architecture Concept
 - Airport Authority Operations
 - Air Carrier AOC, FOC future operational concepts
- **Technology Investigation**
 - Cloud Computing, Resource Sharing
 - Information Centric Networking, Security
 - Cognitive Network Ops, Software Defined Network.
 - Modern Data Link systems
- **Concept Architecture Development**
 - Model Architecture Definition

Requirements Development and Analysis



Who are the Stakeholders?

Airports primarily divided in two areas: Passenger Terminal and Airfield

Airfield

- FAA
 - Air Traffic
 - Technical Operations
- Airlines
 - AOC
 - Ramp Tower, Baggage, Passenger, Maintenance, etc.
 - Aircrew
- Port Authority
 - Airfield Ops.
 - Terminal Ops.
- Ground handling operations
 - Fueling
 - Maintenance
 - Cabin services

Passenger Terminal

- TSA
- Customs
- Parking
- Taxi services
- Shuttle Services
- Rail Services
- Customer Services
- People mover Systems
- Local DoT
- Car Rentals
- Gate agent services
- Passengers



3. Airport Architecture Concept



Architecture Approach Options

- Information exchange through voice communications among principal stakeholders
- New airport network design interconnecting stakeholders
- Interconnect existing stakeholder owned and operated networks
- Develop new Publish/Subscribe Service Oriented Architecture employing cloud services. Stakeholders publish relevant information
- Support of self-healing networks.



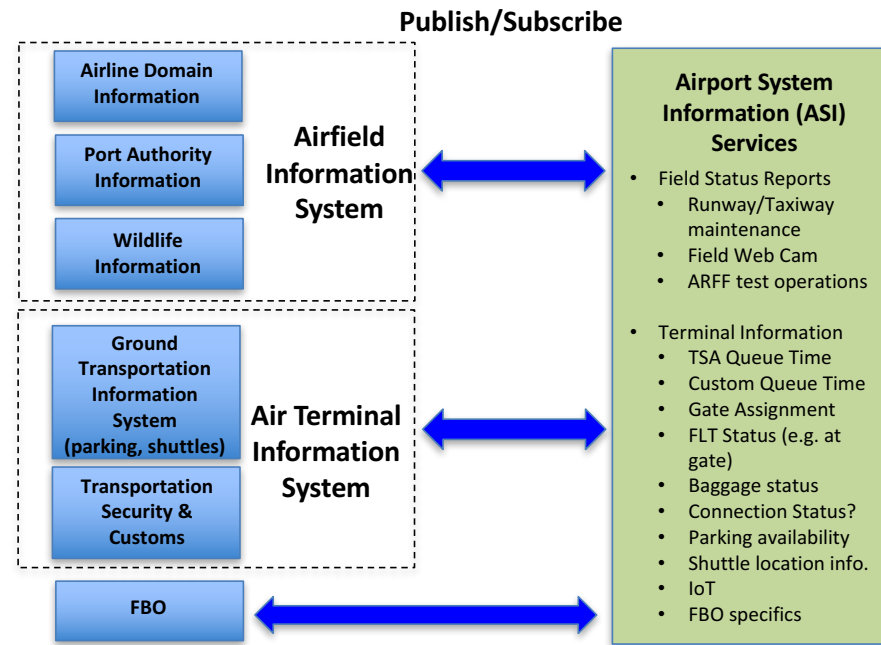
Airport Information Exchange Architecture Framework - Conceptual

Airport System Information

- Cloud Implementation
 - Publish - Subscribe Service
 - Data Center
- Formalized Services
- Web Services
- Airport Exchange Data Model Definition
- Governance Model not in Project

Characteristics

- High Availability
- Secure
- Scalable
- Resilient
- Real Time Monitoring
- Decouple Publish and Subscribe
- Asynchronous



Airfield Information System: Services and information that impact aircraft on time departure/arrival or overall operation of airport surface system

Air Terminal Information System: Services and information impacting passenger's arrival at departure gate.

Airport System Information: Repository of relevant airport information supporting ATM/ATC, AOC, FOC, Airports, Passenger



Benefits and Information Exchange

Potential Benefits

Improve on-time Pushback
Reduce gate turn around
Optimal Departure/Arrival
Improve Predictability
Increase Airport Capacity
Enable Airport CDM
Lower Operational Costs
Improve Coordination
Improve Flow of People
through Airport
Improve connection times
Gate Assignment Planning

Airfield Information

Airport Authority

- Lighting
- Construction
- Security

Airline

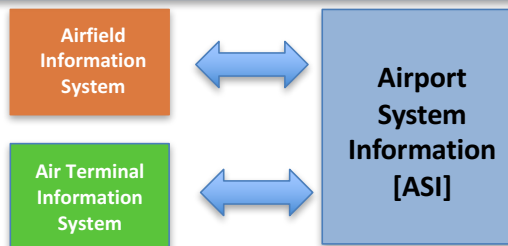
- Fueling
- Baggage
- Catering

Weather

De-Icing

Air Terminal Information

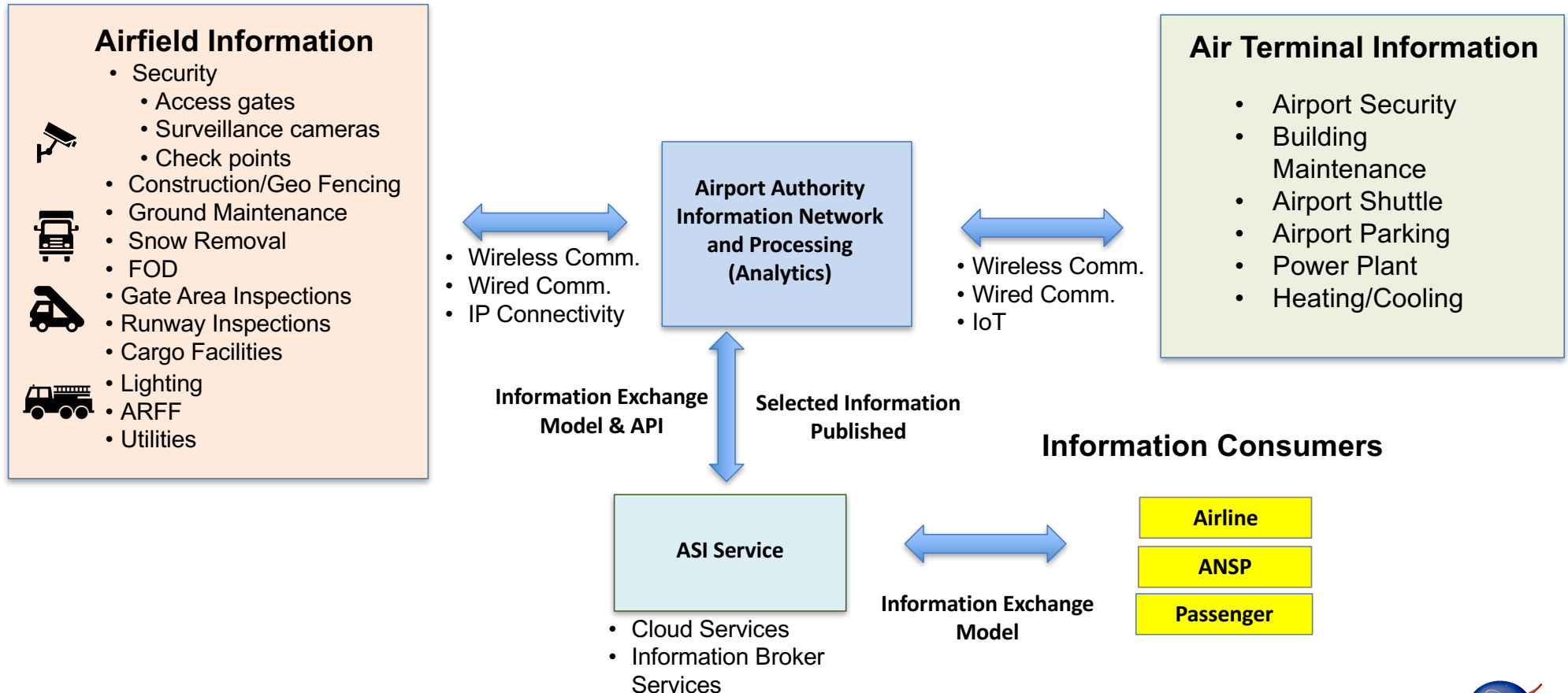
Parking
Shuttle
TSA Queue
Customs
Security
IoT
....



Airport Network Architecture - Facility Information Flow



Airport Authority Information Exchange - Sample

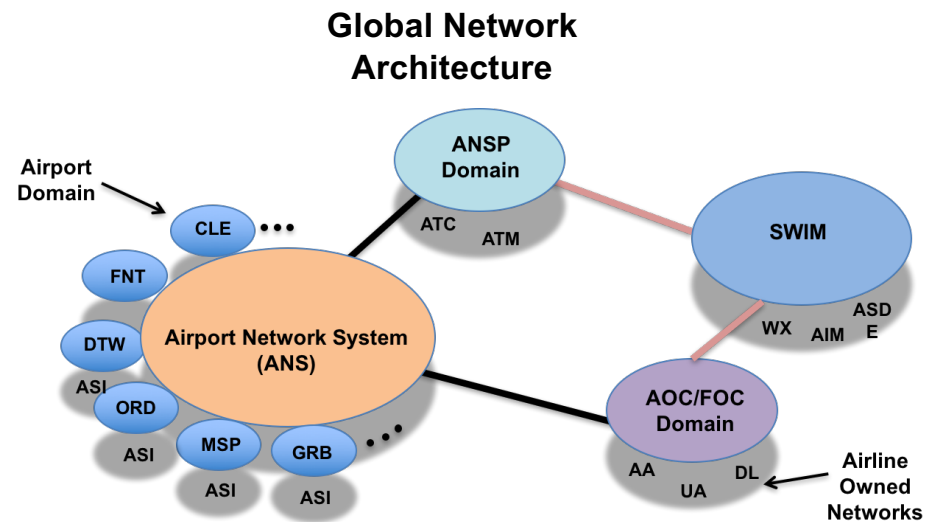


Global Airport Architecture System – Conceptual

Airport Network System (ANS)

Large scale multi-airport domain network

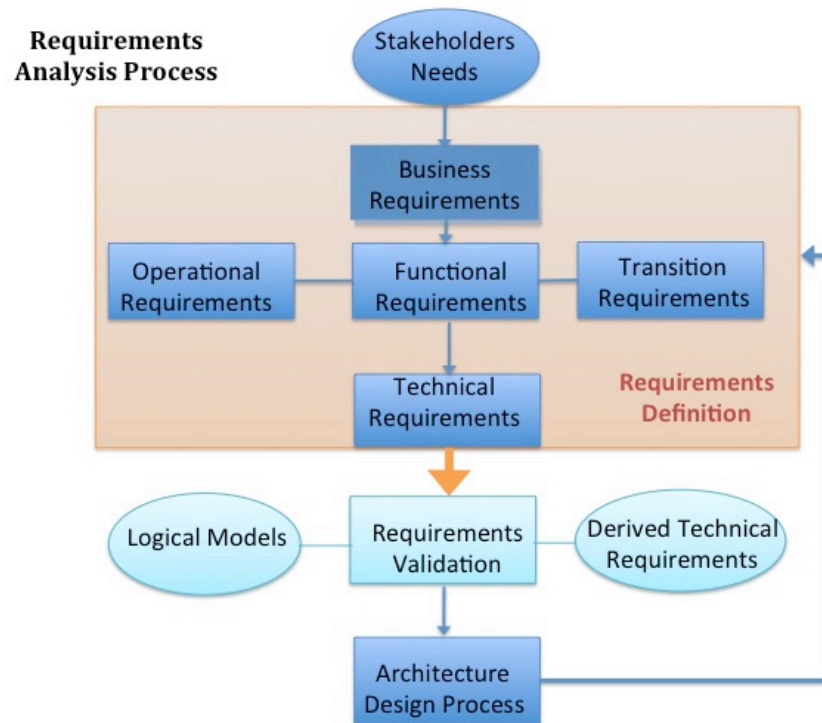
- Shared brokered network
- Each domain hosts regional airports
- Distributed/federated system
- Data exchange model
- Cloud enabled
- Information offered to:
 - ANSP
 - Airlines
 - Cargo
 - Airports
 - Passengers



4. Requirements Development



Requirement Analysis



Port Authority Requirements - Sample

- **FAR 139 Safety Inspection**

- Navigational Aids System Maintenance
- Signage
- Pavement Management System
- FOD management
- AOA Incident Reporting
- AOA Restricted Area Access Control
- Work Order Generation, Dispatch & Verification
- Snow Removal Monitoring and Ice Control
- Weather Monitoring
- Wildlife Management System
- Construction Management System
- Vehicle Inspections (outside Air Field)
- Vehicle Inspections (inside Air Field)
- Building room Inspections
- Rules and regulation enforcement

- **Requirements**

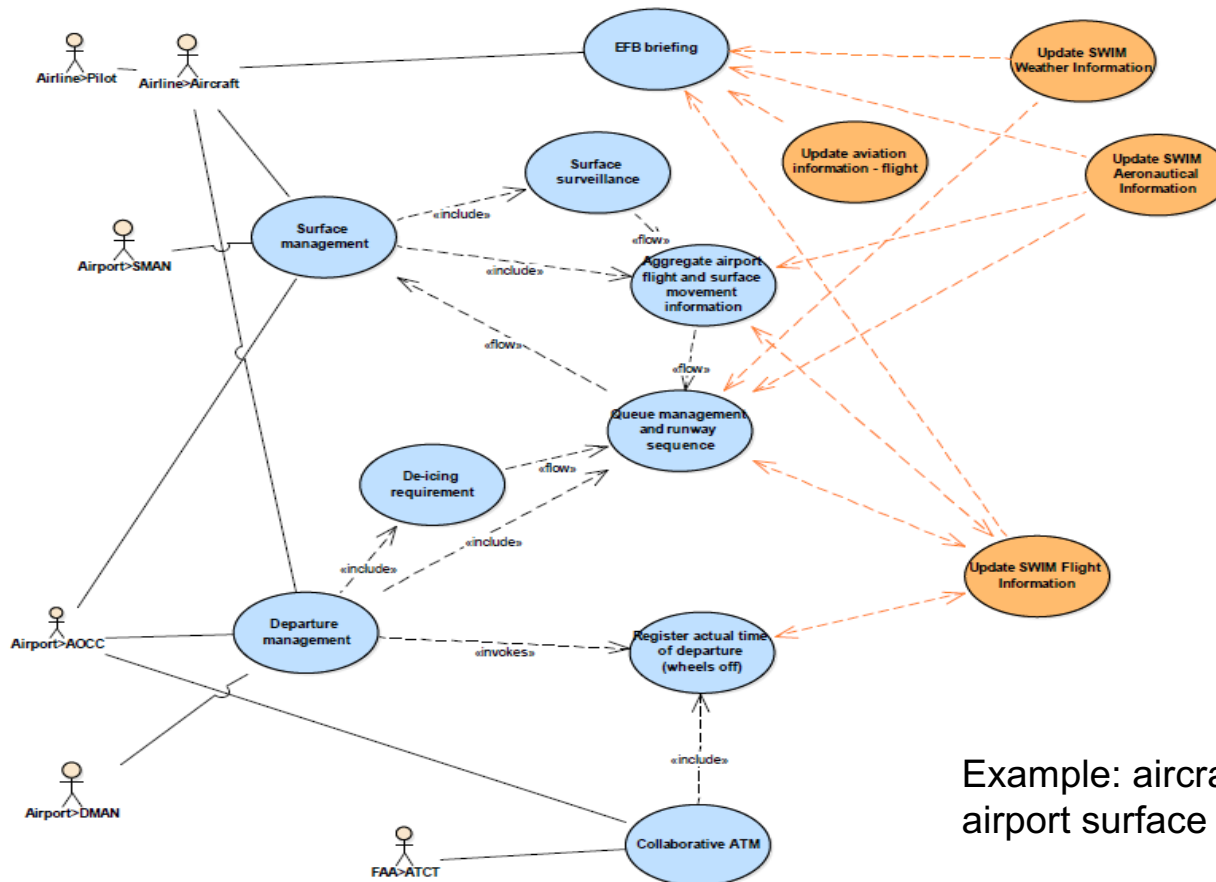
- Availability: 0.9999
- Duplicity: full duplex
- Latency: 50 msec
- Throughput: 64 kbps
- Symmetry: Full symmetry
- Content: text/light graphics
- Transport Protocol: TCP/IP
- Interface: Ethernet
- Service Recovery: Medium Priority
- Source Equipment: varies
- Sink Equipment: Server



5. Use Cases & Information Flows



Use case analysis: Use case diagrams



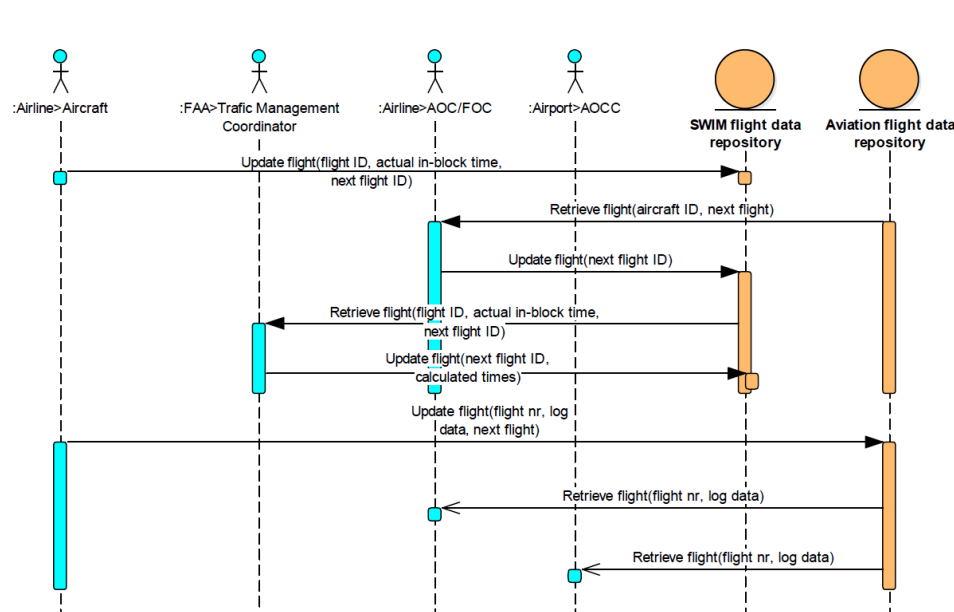
- Identify actors and actions
- Functional relations and dependencies
- No sequential information
- Independent from networking or technology

Example: aircraft departure on airport surface

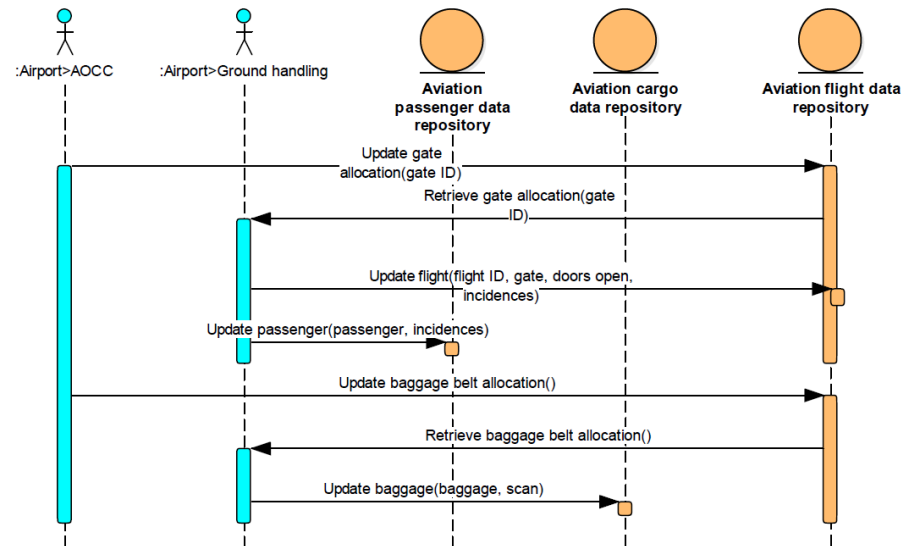


Use case analysis: Information flow diagrams

- Show the sequence of message exchanges required to execute the nominal case of a use case
- Independent from lower level network components

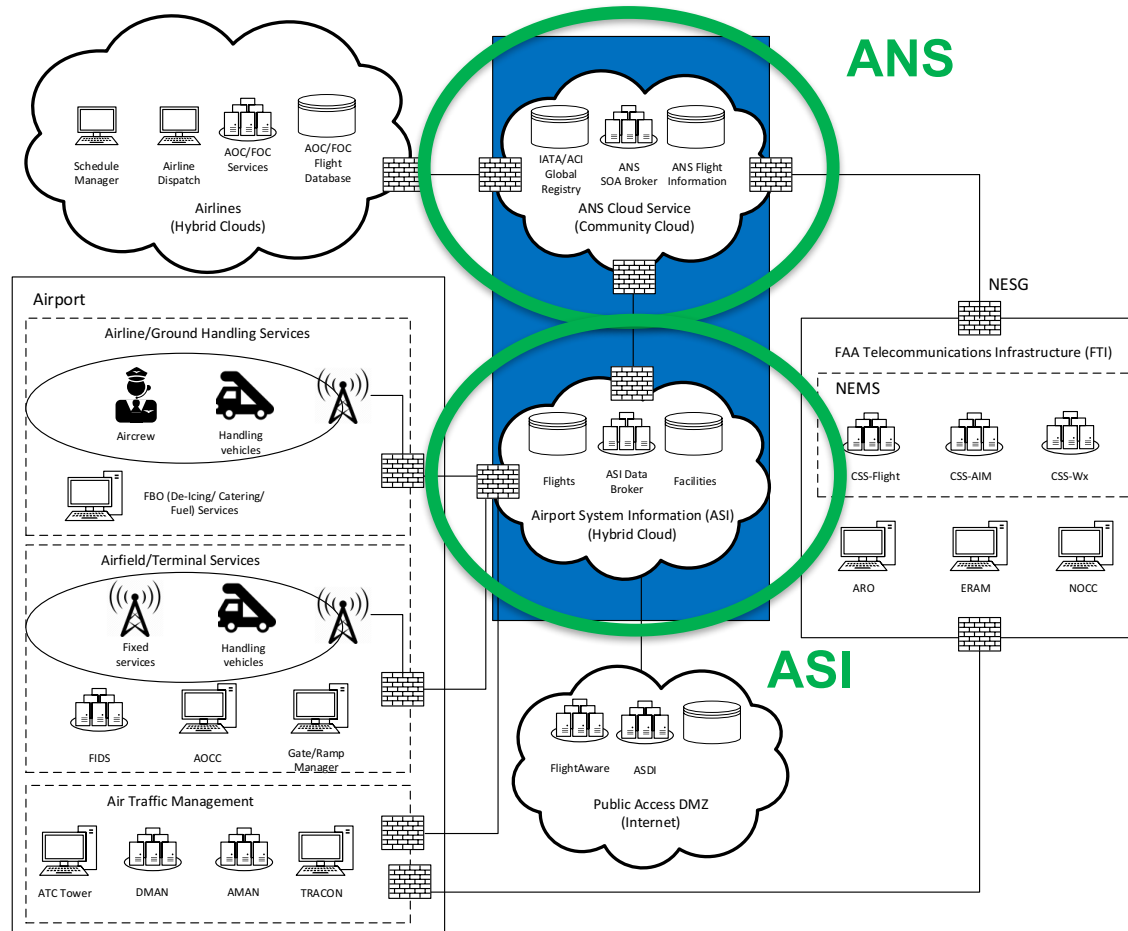


Post-arrival process: a) Airside



b) Groundside

Use case analysis: Logical architecture



- Defines essential elements and functions to support use cases and information flows
- Data consumers, producers and processors

6. Future Work and Conclusion



Tasks FY-2017

Concept Exploration Definition

– Communications Link Evaluation

- Wired and Wireless Communications Technology Identification
- Wired and Wireless Communications Technology Selection
- Wired and Wireless Communications Technical Parameter Definition

– Information Exchange Architecture

- Scenario Development
- Data loading Model Development
- Architecture Development
- Simulation Tool Assessment and Selection



Conclusion

- Implementation of information sharing infrastructure and technologies will greatly enhance real time decision-making and enable **Airport System context awareness**.
- **Airport Context Awareness** will enable airport users to identify **who** is using services/facilities, **what** resources are in use, **state** of resources, operational service **limitations**, **capacity** management and others.
- Airport System context awareness will enable **Precision Operations**

